Implementing INSPIRE for the Czech Cadastre of Real Estates

Jiří Poláček, Petr Souček

The Czech Office for Surveying, Mapping and Cadastre (COSMC)
Prague, the Czech Republic

Jiri.Polacek@cuzk.cz   Petr.Soucek@cuzk.cz

Abstract

The article is dedicated to the topic of the implementation of INSPIRE directive within the Information System of the Czech Cadastre of Real Estates. The procedure of implementation of the INSPIRE directive for cadastral related themes, which started in 2008, is followed. Currently running view and download services as well as experience with its operational run are described. Finally an overview of the implementation problems and scheduled follow-up activities are outlined.

Keywords: INSPIRE, implementation, Cadastre of Real Estates, view service, download service, WMS, WFS

1. Introduction

This contribution is dedicated to the topic of the implementation of INSPIRE directive within the Information System of the Czech Cadastre of Real Estates.

Czech Cadastre of Real Estates is open concerning provision of information. The cadastral mapping in the Austrian Empire started in 1817 by an imperial directive, which enabled to denunciate and obtain this way neighbour's property, if he did not enter his Real Estate to the Cadastre. For this purpose was Cadastre publicly open from the very beginning. The principle of openness showed to be very useful after mortgages have been introduced in the Cadastre evidence as well. Since that, Cadastre in our country is open; everybody can view it for free. The Czech GIS users are since 1993 supported by cadastral data services (generally paid) involving exchange format for the written part and digital cadastral map as well as scanned cadastral maps in raster form. The access to cadastral information is also according to the Czech cadastral law very open. The accessibility of cadastral information was improved by the Information System of Cadastre of Real Estates (ISCRE), launched in 2001, especially with:

- Establishing the central database which contains cadastral data of the whole territory of the Czech Republic and being updated every 2 hours.

- The application called "Remote Access"(RA), which is generally paid and for registered users only. RA is a comprehensive application with a broad variety of functions, which enables an on-line access to cadastral information.

As a reflection of necessary need of free cadastral information, COSMC prepared the application called "Viewing Cadastre", which started with the operational run in 2004. The application enables to access basic data linked with specified property (owner, area, culture etc.), it's first version handled with the descriptive information only. This free application

became in a short time the most frequently visited governmental web page within the Czech Republic. Recently we can monitor more than 1.8 mil. visits per month, more than 1,500 parallel users in rush hours (see following table)

	visits (thousands)	IP addresses (thousands)	data amount (GB)	hits (millions)
2007	670	132	76,1	29,755
2008	1026	197	876,4	116,841
2009	1118	235	1351,1	149,353
2010	1247	291	1770,8	210,744
2011	1748	366	4145,9	357,198
2012*	1980	394	5343,3	456,408

Table 1: Average monthly statistics of demands on Viewing Cadastre application (* 9 months)

2. INSPIRE implementation process in COSMC

Shortly after the INSPIRE directive entered into force in May 2007, preparation of its operational run at COSMC started. The impulse for this activity was the fact, that the approved INSPIRE directive declared free of charge viewing for its themes. Great demand of our users linked with functionality has been expected especially for „Cadastral Parcels" and „Buildings" themes, which represents approximately 85% of the Czech cadastral map content. We started to consider operational requirements and economical aspects of the expected run has been considered and finally a decision to start some kind of viewing services as soon as possible to get an experience has been made. The first version of WMS for the cadastral maps has been launched in April 2008. The exchange format of the digital cadastral map has been used as a source of vector graphical information, in this phase of the project was this information approximately 20 days old. These WMS (free with no registration required) were used to introduce graphical information into the „Viewing Cadastre" application as well.

After data specification of "Cadastral parcels" theme was approved, COSMC took part in testing data specification as a LMO in 2008-2009. We succeeded in making the conversion into the INSPIRE GML format and recognized some conversion problems to solve.

3. Conversion problems

Crucial problem was the conversion of map accuracy. Inside the ISCRE is so called quality code linked with separate measured (or digitized) points, on the other side INSPIRE data specification for the „Cadastral Parcel" theme enables to link accuracy with the parcel boundary line only. This conversion of point accuracy into line accuracy was not easy, because it had to take into account the specific methodology for the creation and maintenance the Czech digital cadastral map and inserting a point with lower accuracy on the straight line could not downgrade the original accuracy. The implementation had to be robust enough because it was proceeded online. As a result, cadastral map with distinction of an accurate and less accurate parcel boundaries has been derived. This output is also wildly used in Viewing Cadastre application as so called "green and red" cadastral map (see picture 1).

Another problem to solve was parcel boundaries in the form of arcs and circles. GML 3.2.1

supports arcs and circles, but data specification for cadastral parcel theme stated, that parcel boundaries can be only in a line form. We had to substitute arcs by polylines, but we store original geometry in GML as well. Furthermore some topological aspects of this conversion had to be taken in account.

Furthermore, improvement of accuracy of the geometrical transformation from the Czech Cadastre coordinate system JTSK to the ETRS 89 has to be mentioned. These activities were carried out by the Research Institute of Geodesy, Topography and Cartography.
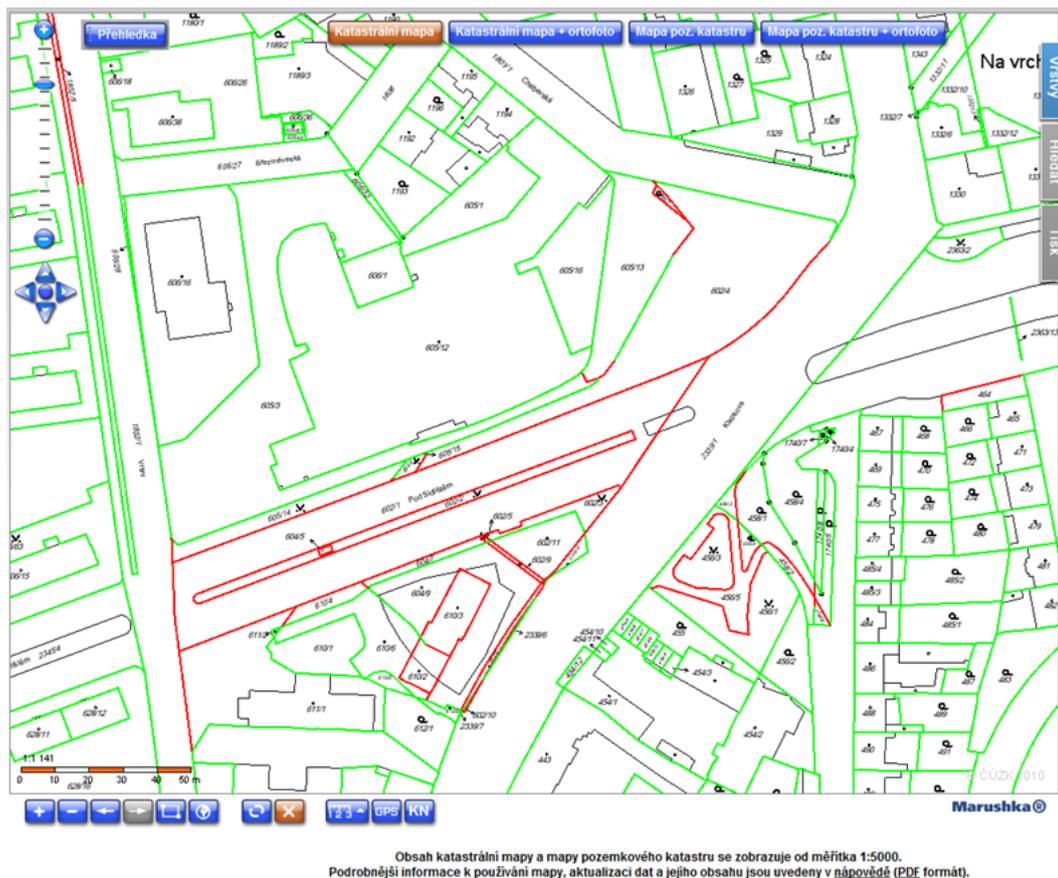

Figure 1: Accuracy of parcel boundaries in Viewing Cadastre application (green – accurate, red – less accurate)

4. Publication Database

After successful testing a discussion about optimal way of INSPIRE implementation within the Czech Cadastre of Real Estates started. It was clear, that ISCRE data structure is so different, that we can't easily adopt INSPIRE data specification inside it. Finally in 2009 a decision has been made to create „Publication database" online linked to the ISCRE database. The goal was not only to implement the INSPIRE directive, but to offer web services, which could enable for our users and internal COSMC applications access up-to-date cadastral maps.

The Publication Database contains graphical data necessary for viewing and download IN-SPIRE services. Original graphical data are converted into ISO model (harmonized form).

Data are updated on the fly from the source ISCRE database, in near future also from the territorial identification system for the Addresses and Administrative Units themes (see chapter "Download services"). Updating process is accomplished using Oracle PL/SQL scripts and replications. Inside this database is being the necessary conversion performed. The conversion covers necessary input data checking (including the topological ones).

Probably the most laborious part of the implementation was the incremental concept of updating the Publication database, especially to link database transactions performing the conversion with replications of changes, and to maintain error conditions. This process had to be sophisticated and robust enough to manage changes in 2-hours period.

The services (WMS, WFS) provided from this database handle with data approximately 2 hours old.

5. View services

View service for "Cadastral parcels" theme is available on the address http://services.cuzk.cz/wms/inspire-cp-wms.asp. This service was launched on 9.5.2011 and is available for free with no registration required. The Service runs using harmonized data of the Cadastral parcel theme. The complete cadastral map contains a non-harmonized WMS (broadening of the harmonized one) on http://services.cuzk.cz/wms/wms.asp.

The harmonized service offers following layers:

- Parcel Boundaries and parcel numbers (up to the 1:20 000 scale)
- Parcel Boundaries (up to the 1:20 000 scale)
- Boundaries and Names of the cadastral units (up to the 1:100 000 scale)

See selected samples at Figure 2.

6. WMS operational run and INSPIRE implementation problems

The demand for this service has been instantly growing as shown on the following table; for instance in 2011 the number of visits of WMS reached almost 70, 000 per month, with more than 22, 800 unique IP addresses, almost 23 mil. hits (get map) and more than 208 GB of uploaded data. In rush hours the number of requests is more than 3,500 per minute.

	visits (thousands)	IP addresses (thousands)	data amount (GB)	hits (millions)
2008	19,4	5,5	24,7	1,0
2009	32,4	6,7	54,7	3,0
2010	41,4	8,9	105,1	8,5
2011	70,0	22,9	208,6	23,0
2012**	151,8	50,5	253,3	42,5

Table 2: Average monthly statistics of demands on WMS (** - 9 months)

The general trouble with operational run of free service linked to the wildly used applications is that it is almost impossible to guarantee optimal reaction time for it under all circumstances. For example, publishing a link to the Viewing Cadastre application (which is using WMS) by
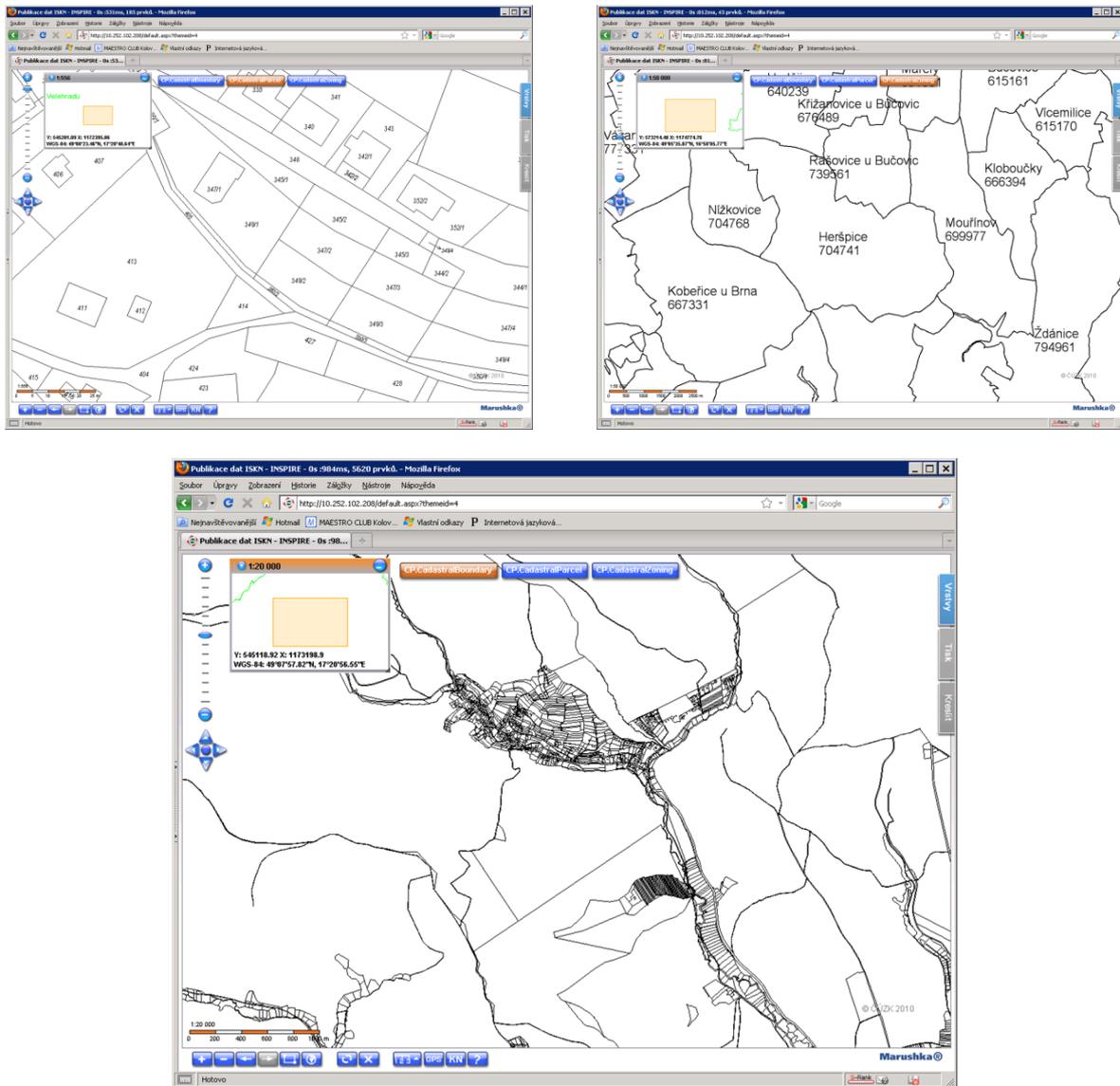
Figure 2: Samples of WMS layers

an electronic version of a popular newspaper caused, that demand on the application raised five times more within few hours and as a result responses of WMS exceeded required limits.

Common problem of the INSPIRE implementation is term of publication of implementing rules and technical guidelines. Some of them are published so late, that it is difficult to keep deadlines. For example Technical Guidance for the implementation of INSPIRE Download Services has been published on June the 14. It's a bit late considering that we should start this service in the non-harmonized form on 28.th June. The implementation is also negatively influenced by the fact, that OGC, ISO a INSPIRE standards differ and are significantly shifted in time. For example INSPIRE metadata and data specifications are related to different versions of ISO Standard.

The requirements on the implementing staff should be mentioned in this context. These people must be experts in a specific theme (in our case in the Cadastre of Real Estates) and at the same time govern technologies like UML, GML e.g. on a high level.

7. Download services

Further progress of the services connected with the implementation of the INSPIRE directive in the Czech Republic has been significantly influenced by establishing the base registers being a part of the Czech e-government, done especially by a principal decision to provide the data from the Base Register of Territorial Identification, Addresses and Real Estates (BRTIARE) free of charge. The content of this register practically covers the requirements for the following themes: "Cadastral parcels", „Buildings", "Addresses" and "Administrative units". This is the reason why it was decided to provide the download services of those INSPIRE themes free of charge, without any registration as well.

21.5.2012 launched COSMC pilot run of INSPIRE download services for the "Cadastral parcels" theme. Operational run of this service started on 22.6.2012. This service provides data in a vector form from already digitized regions (approximately two thirds of the Czech Republic territory).

This download services are provided for free, no registration is required. Both download service for pre-defined data set and direct access download service (WFS) are supported. Data and services are harmonised according following specifications:

- Draft Implementing Rules for Download Services (Version 3.0).

- INSPIRE Data Specification on Cadastral Parcels - Guidelines v 3.0.1.

Pre-defined data set:

Pre-prepared files (GML version 3.2.1) are updated once daily, separate file for each Cadastral Unit is being created.

Coordinate systems supported for pre-defined data set:

Name	EPSG	File location
S-JTSK Krovak East North	5514	http://services.cuzk.cz/gml/inspire/cp/epsg-5514/
ETRS 89	4258	http://services.cuzk.cz/gml/inspire/cp/epsg-4258/

File names are structured as xxxxxx.zip, where xxxxxx means 6-digits code for Cadastral Unit (according following Cadastral Unit code list) http://www.cuzk.cz/Dokument.aspx?PRARESKOD=10&MENUID=10015&AKCE=DOC:10-CISE_KUAP.

8. Direct access download service

For WFS (web feature service) is following functionality supported: GetCapabilities, DescribeFeatureType, ListStoredQueries, DescribeStoredQueries a GetFeature according 2.0.0 version of the OGC Standard (http://www.opengeospatial.org/standards/wfs). Basic url to link WFS is http://services.cuzk.cz/wfs/inspire-cp-wfs.asp. Some applications require full address including GetCapabilities: http://services.cuzk.cz/wfs.asp?service=WFS&version=2.0.0&request=GetCapabilities.

XSD for the download service is located on http://services.cuzk.cz/xsd/wfs/BasicFeature/.

WFS limits:

- for CadastralBoundaries and CadastralParcels is the request limited on the area of 1 km^2 and 10000 elements,
- for CadastralZoning the limit is 400 km^2 and 500 elements,
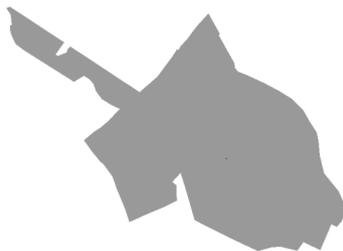- general SQL is not supported.

Supported coordinate systems:

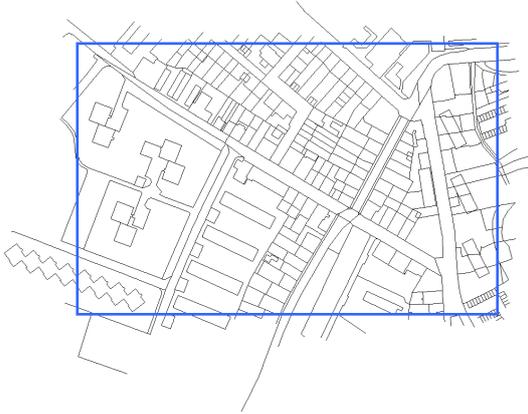| Name	EPSG code
S-JTSK Krovak East North	102067
S-JTSK / Krovak	2065
Pulkovo 1942 / Gauss-Kruger CM 15E	2493
Pulkovo 1942 / Gauss-Kruger CM 21E	2494
ETRS89 / LAEA Europe	3035
WGS 84 / World Mercator	3395
Popular Visualisation CRS / Mercator	3785
WGS 84 / Pseudo-Mercator	3857
ETRS89	4258
WGS 84	4326
S-JTSK / Krovak East North	5221
S-JTSK/05 / Modified Krovak	5224
S-JTSK/05 / Modified Krovak East North	5225
S-JTSK / Krovak East North	5514
S-42 zone 3 S-42 zone 4	28403 28404
WGS 84 / UTM zone 32N	32632
WGS 84 / UTM zone 33N WGS 84 / UTM zone 34N	32633 32634
WGS 84 / Spherical Mercator	900913

8.1. Examples of calling

Getting specific parcel (by PAR ID)

```
http://services.cuzk.cz/wfs/inspire-cp-wfs.asp?SERVICE=WFS&VERSION=2.0.0&
   REQUEST=GETFEATURE&TYPENAMES=CadastralParcel&srsName=urn:ogc:def:crs:EPSG::5514&
FILTER=<Filter xmlns="http://www.opengis.net/fes/2.0"
   xmlns:gml="http://www.opengis.net/gml/3.2"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
   <ResourceId rid="1623333801"/>
</Filter>
```

Getting specific area (by BBOX)

```
http://services.cuzk.cz/wfs/inspire-cp-wfs.asp?service=WFS&version=2.0.0&
  request=GetFeature&typenames=CadastralBoundary&
  BBOX=-757125,-990823,-756712,-990556&srsName=urn:ogc:def:crs:EPSG::5514
```


9. Conclusions

Download services, which are now being run for "Cadastral Parcels" theme, will be in the first half of 2013 complemented by "Addresses" and "Administrative Units" themes. The term for similar service for "Buildings" theme depends on the approval of the final draft for its data specification.

The concept of the Publication database proved to be very liable. Using one technological infrastructure, online WMS are provided both strictly according to the INSPIRE implementing rules and even an enhanced form is run, covering content of the whole cadastral map (including its raster form). A great number of external user's applications are now based on these services, as well as COSMC applications like Viewing Cadastre, Base Register of Territorial Identification and the branch Geoportal. Furthermore the Publication database enables online editing of the dynamic part of metadata, checking graphical cadastral data and is used for some managerial and planning purposes as well.